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Region VIII
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Colorado River Basin Water Quality Control Project

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Report on Colorado River Basin Water Quality Control Project.

16. Abstracts

This report contains available radium-226 and uranium results received through September 24, 1962, from analysis of composite water samples at the sampling locations of the Radium Monitoring Network established by the Colorado River Basin Water Quality Control Project. This report is the first release of such data. The Radium Monitoring Network is a surveillance system consisting of continuous surface water sampling at 23 significant locations throughout the basin. It assays the radiological content of river water over the entire basin. Tabular data are presented that are below the currently accepted MPC value for radium-226.

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COLORADO RIVER BASIN WATER QUALITY CONTROL PROJECT

RADIUM MONITORING NETWORK

Introduction

This report contains available radium-226 results received through September 24, 1962 from analysis of composite water samples at the sampling locations of the Radium Monitoring Network established by the Colorado River Basin Water Quality Control Project. This report is the first release of such data. It is planned to make similar information available in the future on a quarterly basis.

The Radium Monitoring Network is a surveillance system presently consisting of continuous surface water sampling at twenty-three significant locations throughout the Colorado River Basin. The purpose of this network, ultimately to consist of about 27 sampling locations, is to assay the radiological content of river water over the entire Colorado River Basin on a continuous basis. On October 22-23, 1957, a conference on uranium milling wastes was held at Cortez, Colorado, and was attended by representatives of the States of Arizona, Colorado, New Mexico, and Utah, and the Public Health Service. At this meeting, a Radium Monitoring Network to provide needed continuous data was suggested. Accordingly, when the Colorado River Basin Project was organized, planning began to institute such a surveillance network.

In the late summer of 1960 a field reconnaissance trip was made to select tentative locations for Radium Monitoring Network sampling stations. The first continuous station was established in January, 1961. As funds, equipment and manpower have become available, additional stations have been added to the network. Sampling began at the majority of locations late in 1961. Originally a system of continuously operating automatic sampling devices was conceived. However, due to extreme climatic conditions occurring in the Basin, fluctuation of river stages, and lack of experienced local manpower, this concept has been modified. Currently seven stations are served by automatic sampling devices. The balance of active stations are sampled on a grab-sample basis three to six times a week by private individuals. Samples collected are routinely being composited on a monthly basis for analysis. In a number of cases, however, analyses of weekly composites have been run.

In general, three criteria have been used in selecting the locations for the various Radium Monitoring Stations. A number of stations are located to provide information on base-line or background levels of radioactivity. These stations are located upstream of all known industrial sources and hence serve as a measure of naturally occurring or "background" radiological conditions. Other stations located downstream of uranium milling activities assess the effects of such industry on the dissolved radium content of the stream. Stations which will be established in the Lower Main-Stem Sub-Basin will aid in assessing the significance in this area of dissolved radioactive materials originating in the Upper Basin.

Twenty-three Radium Monitoring Network Stations are currently operating. Thirteen stations are located in the Upper Main-Stem Sub-Basin; seven stations in the San Juan Sub-Basin; two stations in the Green Sub-Basin; and one at the northerly U. S.-Mexican Border. The Radium Monitoring Network will be expanded

to its full coverage in the near future by addition of four sampling locations on the main stem of the Colorado River in the river reach from Lees Ferry to Parker Dam. The locations of the monitoring stations are indicated on the enclosed Basin map.

General Remarks on Appended Data

1. When viewed as a whole, all of the reported data for dissolved radium-226 are below the currently accepted MPC value for radium-226 of 3.0 μμg/1. Specifically, combining all background and non-background stations, the data shows:

   Average Ra-226: 0.28 μμg/1
   Range: 0.0 - 2.7 μμg/1
   Number of samples: 172

2. Grouping all stations together which are unaffected by uranium mining and milling activities (background stations), the data shows:

   Average Ra-226: 0.06 μμg/1
   Range: 0.0 - 0.32 μμg/1
   Number of samples: 52

3. The data from all non-background stations shows:

   Average Ra-226: 0.38 μμg/1
   Range: 0.04 - 2.7 μμg/1
   Number of samples: 120

The above data illustrates other comparisons which are given as follows:

1. The possible influence of radium contributed to the main stem of the Colorado River by the Dolores River is indicated by the increase noted between stations RMN 6 (Colorado River above Fruita) and RMN 9(Colorado River above Moab). Average results at these stations were, respectively, 0.14 μμg/1 and 0.27 μμg/1. Additional data and further evaluation are required, however, before other than a tentative conclusion may be reached.

2. Data from four stations in the San Miguel-Dolores River system show the following:

   RMN-17: San Miguel River above Naturita, Colorado (background station)
   Average Ra-226: 0.04 μμg/1
   Range: 0.0 - 0.06 μμg/1
   Number of samples: 23

   RMN-18: San Miguel River above Uravan, Colorado
   (Below Vanadium Corporation of America mill)
   Average Ra-226: 0.21 μμg/1
   Range: 0.09 - 0.30 μμg/1
   Number of samples: 20

RMN-20: San Miguel River below Uravan, Colorado
(Below Union Carbide Nuclear Corporation mill)
Average Ra-226: 0.95 μμg/l
Range: 0.29 - 2.7 μμg/l
Number of samples: 17

RMN-21: Dolores River at Bedrock, Colorado
(Below mining and milling at Slick Rock)
Average Ra-226: 0.52 μμg/l
Range: 0.08 - 1.0 μμg/l
Number of samples: 11

These data clearly show the effect of uranium milling activity in the Uravan-Naturita area on the dissolved radium entering the San Miguel-Dolores River system. The dissolved radium is apparently increased from a background level of 0.04 μμg/l to 0.21 μμg/l below the Vanadium Corporation of America upgrader at Vancorum and to 0.95 μμg/l below the Union Carbide Nuclear Corporation mill at Uravan.

It is also noted further that the dissolved radium content of the San Miguel River above Uravan has increased gradually since November, 1961. This increase would appear to be the result of beginning of upgrading activities at the Vanadium Corporation of America mill late in 1961. The average radium-226 value of 0.95 μμg/l below Uravan is lower than the average value of 2.4 μμg/l found in 1960 at this location,[1/] and indicates improved radiological conditions below the Uravan Mill. However, it should be pointed out that these results are the highest encountered in the Radium Monitoring Network.

3. The data from the two stations on the Animas River are also summarized below:

RMN-11: Animas River at Durango, Colorado (background station)
Average Ra-226: 0.05 μμg/l
Range: 0.04 - 0.06 μμg/l
Number of samples: 7

RMN-12: Animas River at Colorado-New Mexico State Line
Average Ra-226: 0.37 μμg/l
Range: 0.12 - 1.0 μμg/l
Number of samples: 29

These results indicate a substantial improvement in radiological condition of the river below the Vanadium Corporation of America's Durango Mill. The average radium-226 value of 0.37 μμg/l is considerably lower than the average value of 7.6 μμg/l found during the summer of 1958 at this station.[2/]

1/ Stream Surveys in Vicinity of Uranium Mills III. Area of Uravan, Slick Rock and Gateway, Colorado - August 1960, Public Health Service, Colorado River Basin Water Quality Control Project, Denver, Colorado, September 1961.

2/ Survey of Interstate Pollution of the Animas River (Colorado-New Mexico), Public Health Service, Robert A. Taft, Sanitary Engineering Center, Cincinnati, Ohio, May 1959.

The information presented above shows the considerable merit of a radium monitoring network in the Colorado River Basin and the ability of such a network to distinguish clearly between background versus non-background conditions in the Basin with regard to radium-226. The variability observed in the raw data is no more than would be expected on the basis of flow patterns and sampling techniques.

RMN Station 1: Colorado River at Silt, Colorado
Started: November 25, 1961
Type: Automatic Pump-timer - 1 week composites

Date	μμg Radium-226/liter
1961	
Nov. 25-Dec. 2	0.19
Dec. 2-9	0.17
Dec. 9-16	0.18
Dec. 16-23	0.15
Dec. 23-30	0.32
1962	
Feb. 18-24	0.15
Feb. 24-Mar. 3	0.16
Mar. 3-31	0.14
Mar. 31-Apr. 28	0.13
June 30-July 28	0.11

RMN Station 4: Colorado River above DeBeque, Colorado
Started: November 12, 1961
Type: Automatic Pump-timer - 1 week composites

Date	μμg Radium-226/liter
1961	
Nov. 12-18	0.23
Nov. 18-25	0.19
Nov. 25-Dec. 2	0.17
1962	
Feb. 18-24	0.15
Feb. 24-Mar. 3	0.15
Apr. 28-June 3	0.09
June 3-30	0.05
June 30-July 28	0.09

RMN Station 5: Gunnison River above Grand Junction, Colorado
Started: April 16, 1962
Type: Six daily grab samples per week

Date	μμg Radium-226/liter
1962	
Apr. 16-28	0.04
Apr. 30-June 2	0.07
June 4-30	0.04
July 2-28	0.04

RMN Station 6: Colorado River near Fruita, Colorado
Started: April 16, 1962
Type: Six daily grab samples per week

Date	μμg Radium-226/liter
1962	
April 16-28	0.12
Apr. 30-June 2	0.13
June 4-30	0.09
July 2-28	0.20

RMN Station 9: Colorado River above Moab, Utah
Started: December 11, 1961
Type: Six daily grab samples per week

Date	µµg Radium-226/liter
1961	
Dec. 11-30	0.34
1962	
Jan. 1-27	0.38
Jan. 29-Mar. 3	0.30
Mar. 5-31	0.28
Apr. 2-28	0.25
Apr. 30-June 2	0.16
June 4-30	0.20

RMN Station 10: Colorado River below Moab, Utah
Started: December 11, 1961
Type: Six daily grab samples per week

Date	µµg Radium-226/liter
1961	
Dec. 11-30	0.41
1962	
Jan. 1-27	0.48
Jan. 29-Mar. 3	0.36
Mar. 5-31	0.34
Apr. 2-28	0.30
Apr. 30-June 2	0.25
June 4-30	0.18

RMN Station 11: Animas River at Durango, Colorado
Started: July 17, 1961
Type: 6 daily grabs per week 7/17-9/9/61 except as noted

Date	μμg Radium-226/liter
1961	
July 17-22	0.06
July 24-31*	0.06
July 31-Aug. 5*	0.05, 0.04
Aug. 21-28	0.06
Aug. 28-Sept. 4	0.05
Sept. 2-9	0.06

* Automatic Sampler

RMN Station 12: Animas River at Colorado-New Mexico State Line
Started: January 19, 1961
Type: Automatic

Date	µµg Radium-226/liter
1961	
Jan. 19-25	0.75
Jan. 25-31	1.01
Jan.31-Feb. 7	0.82
Feb. 7-14	0.78
Feb. 14-21	0.50
July 24-31	0.24
Sept. 11-18	0.19
Sept. 18-25	0.12
Sept. 25-Oct. 2	0.13
Oct. 2-9	0.16
Oct. 9-16	0.17
Oct. 16-23	0.19
Oct. 23-30	0.24
Oct. 30-Nov. 6	0.21
Nov. 6-13	0.23
Nov. 13-20	0.27
Nov. 20-27	0.25
Nov. 27-Dec. 4	0.26
Dec. 4-13	0.40
Dec. 13-18	0.43
Dec. 18-26	0.43
Dec. 26-Jan. 2	0.46
1962	
Jan. 2-8	0.38
Jan. 8-15	0.33
Jan. 15-22	0.46
Jan. 22-29	0.43
Jan. 29-Feb. 5	0.43
Feb. 5-12	0.33
Feb. 12-19	0.34
Feb. 19-26	0.36
Feb. 26-Mar. 5	0.51
Mar. 5-Apr. 2	

RMN Station 12 (Continued)

Date	μμg Radium-226/liter
1962	
Apr. 2-28	0.34
Apr. 30-June 2	0.24
June 4-July 2	0.14
July 2-30	0.19

RMN Station 15: San Juan River above Mexican Hat, Utah
Started: December 11, 1961
Type: 6 daily grab samples per week

Date	μμg Radium-226/liter
1961	
Dec. 11-30	0.18
1962	
Jan. 1-27	
Mar. 5-31	0.14
Apr. 2-28	0.08
Apr. 30-June 2	0.10
June 4-30	0.10
July 2-28	0.15

RMN Station 16: San Juan River below Mexican Hat, Utah
Started: December 11, 1961
Type: 6 daily grab samples per week

Date	μμg Radium-226/liter
1961	
December 11-30	0.34
1962	
January 1-27	0.14
Jan. 29-Mar. 3	0.12
March 5-31	0.09
April 2-28	0.10
Apr. 30-June 2	0.06
June 4-30	0.09
July 2-28	0.29

RMN Station 17: San Miguel River above Naturita, Colorado
Started: October 28, 1961
Type: Automatic

Date	µµg Radium-226/liter
1961	
Oct. 28-Nov. 4	0.00
Nov. 4-11	0.04
Nov. 11-17	0.05
Nov. 17-25	0.02
Dec. 17-24	0.03
Dec. 24-31	0.01
1962	
Dec. 31-Jan. 5	0.00
Jan. 5-13	0.03
Jan. 13-21	0.01
Jan. 21-28	0.04
Jan. 28-Feb. 3	0.04
Feb. 3-10	0.03
Feb. 10-18	0.04
Feb. 18-25	0.06
Feb. 25-Mar. 2	0.06
Mar. 2-11	0.04
Mar. 11-18	0.05
Mar. 18-24	0.04
Mar. 24-Apr. 1	0.06
Apr. 1-29	0.06
Apr. 30-June 3	0.04
June 3-July 1	0.05
July 1-28	0.02

RMN Station 18: San Miguel River above Uravan, Colorado
Started: October 27, 1961
Type: Automatic

Date	μμg Radium-226/liter
1961	
Oct. 27-Nov. 4	0.16
Nov. 4-11	0.12
Nov. 11-17	0.09
Nov. 17-25	0.11
Dec. 17-23	0.18
Dec. 23-30	0.20
1962	
Dec. 30-Jan. 5	0.15
Jan. 5-13	0.28
Jan. 13-21	0.25
Jan. 21-28	0.28
Jan. 28-Feb. 3	0.22
Feb. 3-10	0.26
Feb. 10-18	0.17
Feb. 18-25	0.24
Feb. 25-Mar. 2	0.18
Mar. 2-11	0.30
Mar. 11-18	0.24
Mar. 18-25	
Mar. 25-Apr. 1	0.23
June 3-July 1	0.38
July 1-28	0.24

RMN Station 20: San Miguel River below Uravan, Colorado
Started: October 9, 1961
Type: Automatic

Date	μμg Radium-226/liter
1961	
October 9-17	1.0
October 17-23	1.0
October 23-30	0.86
October 27-Nov. 4	1.1
Nov. 4-11	1.3
Nov. 11-17	1.3
Nov. 17-25	0.76
1962	
Jan. 28-Feb. 3	2.7
Feb. 3-10	0.29
Feb. 10-18	0.46
Feb. 18-25	0.95
Feb. 25-Mar. 2	0.57
Mar. 2-Apr. 1	0.38
Apr. 28-June 3	1.2
June 3-July 1	1.1
July 1-28	1.1

RMN Station 21: Dolores River at Bedrock, Colorado
Started: October 30, 1961
Type: 6 daily grab samples per week

Date	μμg Radium-226/liter
1961	
Oct. 30-Nov. 4	0.98
Nov. 6-11	1.0
Nov. 13-Dec. 2	0.64
Dec. 4-30	0.79
1962	
Jan. 1-27	0.51
Jan. 29-Mar. 3	0.41
Mar. 5-31	0.63
Apr. 2-28	0.21
Apr. 30-June 2	0.12
June 4-30	0.08
July 2-28	0.29

RMN Station 22: Tomichi Creek above Gunnison, Colorado
Started: December 11, 1961
Type: 6 daily grab samples per week

Date	μμg Radium-226/liter
1961	
Dec. 11-31	0.02
1962	
Jan. 2-27	0.02
Jan. 29-Mar. 3	0.01
Mar. 5-31	0.02
Apr. 2-28	0.04
Apr. 30-June 2	0.03
June 4-30	0.02

Station discontinued on July 1, 1962

RMN Station 24: Gunnison River above Gunnison
Started: December 11, 1961
Type: 6 daily grab samples

Date	μμg Radium-226/liter
1961	
December 11-31	0.03